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Too Hot To Handle: Managing America's Ecosystems In A Changing Climate

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Too Hot To Handle: Managing America's Ecosystems In A Changing Climate

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Abstract

For over 140 years, Americans and have enjoyed their national parks. In the national parks, nature and history come together to form uniquely public as well as enormously valuable landscapes. Today, America's national parks are in danger of undergoing serious changes. Climate change is going to alter the physical characteristics of the national parks. Many of the parks have changed before, but this change will be the most dramatic. In this report I examine the historical and current mission of the National Park Service. I also examine the past and current valuation of the national parks by the American people. I'm interested to learn if the National Park Service, under pressure from climate change, can fulfill what Americans currently value about the national parks. What I have discovered is that when the first national parks were created ecosystems were protected by accident. National parks were created for their dramatic landscapes, often containing rock and ice. Today, however, one of the major reasons American's value their national parks is their ecosystems. Since the inception of the national parks in 1872 and the National Park Service in 1916, the men and women who have managed the parks have effectively managed ecosystems in the parks. Global climate change, however, will make the management of America's ecosystems much harder. The National Park Service is not up to the task of continuing to be the sole manager of the ecosystems of the parks. The political borders that the National Park Service operates within do not bind the ecosystems in the national parks. Future policies must reflect the management of America's ecosystems precisely because Americans value the ecosystems of the parks and those ecosystems are at stake. In order to preserve ecosystems, then, America ought to create a National Ecosystem Protection Service. The National Ecosystem Protection Service would be a broad, multilateral, scientific agency. It would be tasked with assessing what will happen to ecosystems under climate change and then working with landowners outside the national parks to encourage the longevity of American ecosystems.

Table of Contents

Executive Summary

"I believe that climate change is fundamentally the greatest threat to the integrity of our national parks that we have ever experienced."

- Jonathan B. Jarvis, Director, National Park Service, 2010

The emerging environmental consciousness of the late 19th century, dramatic landscapes, and entrepreneurial forces led to Yellowstone National Park. Before Yellowstone, only a handful of landscapes were publically owned and the country was still indecisive about what to with its recently acquired western lands. When Yellowstone National Park was established in 1872 it left a multifaceted legacy. First, America established the precedent of large federal landholdings. Second, people came under the illusion that this national park and future national parks would be untouched, timeless spaces. These spaces are instead neither unchanging nor timeless. Third, with the establishment of national parks, America had set up wildlife refuges almost entirely by accident.

In 1916, The National Park Service was created in order to manage America's national parks and national monuments. Its task was to ensure that these federally owned spaces remain unaltered for all time. Today, the National Park Service continues to be the manager of America's national parks. However, what exactly about national parks makes them so valuable? And how have those values changed since the inception of the first national park at Yellowstone in 1872?

Perhaps if the values the national parks were first intended to satisfy have changed in the past century, the management of the national parks needs to change as well.

I suggest that Americans now value the ecosystems that their national parks protect. I also suggest that climate change will overwhelm the National Park Service – the National Park Service will not be able to keep the ecosystems of parks unaltered. I propose the creation of a new agency, a National Ecosystem Protection Service, to act as a collaborative agent between federal agencies, state agencies, local authorities, and other landholders to ensure the longevity of America's ecosystems. The National Ecosystem Protection Service would work in the interest of providing the greatest good for the greatest number of people by providing healthy, diverse, ecosystems. If America does not change its policies to save its ecosystems, Americans forgo an opportunity that they will wish they had again.

Acknowledgements

I would like to give thanks to my academic mentors throughout my four years at Syracuse; those people include William Coplin, Hans Peter Schmitz, Jerry Evensky, Jeffery Weinstein, David Richardson and Robert M. Wilson, as well as give special thanks to my advisor for this paper, Peter J. Wilcoxen. I would also like to thank my parents, Kerry and Thomas Morin. Without their continuous love and support, I don't know where I would be. Last of all I would like to thank my late grandfather, Dollard Morin. I was only 11 years old when he took me to my first national park. He took me to Yosemite National Park and I'll never forget the time we spent together. It is to him that I owe the most thanks.

Advice To Future Honors Students

There's a reason you have made it this far – you work hard. Whether things come easy to you or not, over the last four years, you have had to turn in lots of assignments and take your fair share of exams – and you've survived. So now it comes down to is this last challenge. Can you do it? Yes. Yes you can. You're a star. The only piece of advice I would give you is to **start this project as early as you can**. Start reading, writing, and thinking about your topic as early as first semester of your Junior Year. I know the project seems distant but it will come up fast on you. As you probably know, a better project is one that has been brewing in your mind for quite some time. When you start researching, don't worry about where your project will end up. Sooner or later, you will be engaging yourself into new ways of thinking about the material. As long as you start early, you have nothing to really worry about. Although this is probably the biggest project you will ever have done, you can do it. I'm sure of it. Remember, also, to not bury yourself in this project. It's senior year, have a beer. I wish you the best of luck. Godspeed.

Preface

I first became interested in the national parks when I was 11 years old. In the summer of 2003, my mother, father, grandfather and I spent a week in Northern California. But this was not just another customary trip for us. We are very much a middle class family; my mom is an elementary school teacher and my dad has worked at the same place since he was in high school. We didn't vacation often; this trip was a big deal for us. And, there were a few especially memorable moments. I remember my dad pointing to climbers on El Capitan – I remember he said something along the lines of, "look at the people actually trying to climb that thing!" I remember the giant sequoia trees. I remember trying (unsuccessfully) to put my arms around them, like I would try to do with the birch or oak trees back home in Massachusetts.

Photo of My Grandfather and Me at Yosemite

It was wonderful trip for many reasons. To this day, my family and I keep the memory of my grandfather alive by discussing the time we spent in California. Ten years later, I have learned a lot about national parks. I now have backgrounds in both geography and economics and I intend to critically think about the future of our national parks through the lenses of both subjects. The most important thing I have discovered in my research for this paper is the degree to which the physical attributes in the park are vulnerable to change. Before I began my research for this paper, I believed that these places were timeless – that they had been around since the beginning of time and that the American government could easily protect them indefinitely. Instead, it is the case that these places have changed before and will continue to change – and the biggest change to the parks is soon to come. The landscapes of the national parks will soon change at a rapid pace due to global climate change. I'm interested in how the National Park Service currently is planning to adapt the national parks to deal with climate change. I want to know if their plans will be enough to uphold their goal of keeping the parks unaltered from human and non-human effects. I also want to propose additional management techniques to ensure the health and longevity of the parks. I want my grandchildren (and their grandchildren) to be able to enjoy them as much as I did.

Chapter 1: Introduction

Contained within America's national parks are the oldest, tallest living things on earth – the giant sequoia trees in Yosemite. Contained within America's national parks is the greatest collection of geothermal features on the planet – in Yellowstone. Contained within America's national parks are exposed rocks that are half the age of the planet itself – in the Grand Canyon.[1] Together, the national parks are a reminder of one of the most difficult choices in history – restraint. The forefathers of America chose to make these places "inalienable" and "for everyone, for all time". They are incredible symbol of democracy and interdependence with nature. But, these places can change. They are not as timeless as their story suggests. They have changed before and they will change again. They are dynamic as much in their social meaning as in their physical attributes.

With the coming change in our climate, the current managers of the national parks, the National Park Service, will face many challenges in keeping the parks unaltered. According to The National Park Conservation Association, a non-profit focused on protecting America's parks; climate change adds a particularly difficult challenge to the management of America's ecosystems because it "complicates traditional approaches to resource management".[2] In order to prepare for the changes in the landscape, Congress must prioritize what exactly Americans value about the national parks. Admittedly, budget constraints will not allow the

[1] (Runte, 2010)
[2] (The State of America's National Parks, 2011)

National Park Service to perfectly maintain the landscapes of all national parks and some national parks will require less protection from climate change than others. The point is, once the American government knows what Americans value about the parks, it can determine the best possible solutions to keep the parks intact for future generations.

Analyzing the forces behind national parks and the National Park Service allows a better interpretation of how Americans valued the parks in the late 19th century and how they value them in the early 20th centuries. Because the national park system and the National Park Service were established to satisfy *those* (early 20th century) values, it is possible that the National Park Service may not be the best institution to manage everything that Americans value about the parks today. After all, according to the National Park Service Website, "The National Park Service still strives to meet its original goals."[3] Today, perhaps Americans derive different values from the national parks – requiring another agency to step in and work towards those different goals.

Assessing how Americans value the national parks remains incredibly difficult and imprecise. However, it is clear that the near extinction of the buffalo in 1894 was part of the reason why the National Park Service was established – a better management system to protect the things that Americans value and want to keep around.[4] Today, more than just buffalo are in jeopardy. Many, many attributes of the national parks are in jeopardy. Entire ecosystems are in danger.

[3] (National Park Service History, 2014)
[4] (Burns, K. & Duncan, D., 2009)

Many species will have to migrate. Is that National Park Service the best agency to manage species migration? Even though the species will migrate outside of the parks? Perhaps America needs a new agency to better manage its natural spaces and the values that those spaces produce. This paper assesses how Americans valued the parks in the past, how they value them now and how they will value them in the future – a future that will be disadvantaged by a capricious and ongoing change in Earth's climate. The results of this assessment will determine what actions Congress should take to guarantee the satisfaction of present and future values.

Chapter 2: America's First National Park

2.1 Towards the First National Park

As America was expanding and industrializing in the mid to late 19th century, an undertone of environmental consciousness emerged. Writers like Henry David Thoreau and John Muir encouraged people to rethink the human role on Earth. These writers championed nature, as a place to heal and escape from industrial society. Thoreau, though an active local community member and thoughtful contributor to the political dialogue of his time, never cared much for issues far from home and indeed never wrote about what to do with federal land west of the Mississippi. However, Thoreau's work on the deeper meaning of life offers a powerful way to understand the forces that led to the first national park.

Thoreau's lens remains the best lens to look through when evaluating the national park system because he believed that living can only be done with a (perhaps even modest) connection to nature. National parks are the supply to our demand for meaning by way of their attributes such as mountains, wolves, and glaciers. The existence of national parks give visitors the nudge to think like Thoreau – that man and nature are not separate – that the two are rather one in same and that somehow, society has taken us away from this.[5]

Rising environmental consciousness in the mid-19th century combined with the discovery of physical locations where nature was at its best combined to help create the first national park and the national park system. As America expanded,

[5] (Thoreau, 1848)

more and more people explored and wrote about nature. What Americans found and wrote about were among the greatest sights on the earth, including the Grand Canyon in Arizona, the redwood forests of California, and the geysers in Wyoming. And, as they explored their land, Americans told others about these dramatic landscapes. Painters, explorers, and writers communicated their experiences with their reiterations of its beauty. The American pioneer, George Catlin, first proposed the idea of a national park. Although better known as a painter, as he traveled past the frontier and towards the American West, his journal, published in 1841, called for "nation's park, containing man and beast, in all the wild and freshness of their nature's beauty".[6] And although Catlin was more concerned with the fate of the American Indian and the buffalo than the fate of all of America's landscapes, his idea of a publically owned preserved space with multiple attributes is essentially the idea of a national park. In one of Thoreau's works (published posthumously in 1861) titled *Huckleberries,* he also called for public nature spaces that intended for "instruction and recreation". Thoreau wrote, "I think that each town should have a park, or rather a primitive forest, where a stick should never be cut for fuel – a common possession forever."[7]

Another person to think about the national park idea was Dr. Lafayette Bunnell, when he toured Yosemite Valley in 1851. His vivid descriptions led would-be explorers to yearn to see it. Bunnell writes of Yosemite Valley, "Although familiar with nature in her wildest moods, I looked upon this awe-

[6] (Huntley, 2011)
[7] (Thoreau, 1870)

inspiring column with wonder and admiration".[8] After reading Bunnell's journal, in 1855, James Mason Hutchings led the first tourist party into the valley. Hutchings, according to environmental historian Jen A. Huntley, did more than anyone else to make the national parks into what they are today. In her recent book, Huntley argues that it was precisely Hutchings' idea of making the spaces into places where hosts could charge modest fees to stay in the park and the host could use the fees to improve the roads, trails, and other features of the park. This idea would indeed be the model for America's national parks.[9] However, Hutchings model on Catlin's idea would not have come to life without John Conness. In the spring of 1864, Senator John Conness addressed Congress – saying that Yosemite Valley was "not suitable" for development. In 1864, fifteen square miles, including Yosemite Valley and the Mariposa Grove of Sequoia trees, fell under California Protection's with the passage of the Yosemite Land Grant Act. This Congressional act set aside Yosemite as a public park, "inalienable for all time".[10] It was the first government-sanctioned public landscape and the first example of the national park idea.[11] In 1864, Conness's work on Yosemite set the precedent for publically owned land.

John Muir was another famous figure in the formative years of the national park idea. After spending his first summer in the high country of the Sierra Nevada mountain range in 1869, Muir's subsequent emphatic writings and political work

[8] (Bunnell, 1880)
[9] (Huntley, 2011)
[10] (Yosemite Act, 1864)
[11] (Runte, 2010)

encouraged public support for preservation efforts. Muir's writing inspired people to go west and see the new parks. Muir also partnered with railroad companies to draw people westward. Muir wrote about the appeal of the "wilderness" in railroad advertisements.[12] Although Muir knew that the railroad companies were interested in commodifying the land, he also knew that if railroads brought people to the parks, the people would be refreshed by nature – and that was his goal.[13] Muir was a lifetime advocate of the parks, he would continue working (mostly through writing and public appearances) until his death in 1914.

Seven years after Yosemite had been made into a public park, in 1871, President Ulysses S. Grant decided to survey the area around Yellowstone Valley before deciding what to do with the land. Grant commissioned a lengthy, exhaustive survey, costing the United States government close to forty thousand dollars. After the summer of 1871, when the surveyors returned to Washington, they presented their findings to the Grant Administration. Ulysses S. Grant was pleased with the survey results and believed that the best use of the land was federal ownership. In early 1872, Yellowstone was established with 3,500 acres of federal land and became the America's first national park.[14] But although Yellowstone was to be federally managed, it did not follow that Americans needed a National park Service to manage it…yet. Visitation to the park, although it did increase over time (especially with the completion of the Northern Pacific Railroad in 1883), was not very high. Only 300 visitors came to the park in 1872 and only

[12] (Huntley, 2011)
[13] (Muir, 1911)
[14] (Runte, 2010)

5,000 in 1883.[15] Due to low visitation, managing the park was relatively easy and the U.S. Department of the Interior could delegate officials from its staff to manage the park. As written by Yellowstone scholar Paul Schullery, in the years closely surrounding 1872, "there is no evidence that any of them [U.S. federal government officials] thought that this was the first of a type, or that we're going to turn this into a hugely important world institution." But national parks did exactly that – they became a huge world institution.[16]

2.2 The Legacy of Yellowstone National Park

The first national park at Yellowstone not only set the precedent for more parks, but it also set the precedent for what being a national park meant for the space. In 1872, Yellowstone National Park was created as public, permanent, wildlife refuge. Each of these qualities – public, permanent, and wildlife refuge – carries through to future national parks. The managers of the national parks, the National Park Service, are tasked with maintaining these three qualities of each new park. Each of these three qualities also have important implications for how Americans value and understand their national parks.

The public nature of the parks makes them incredibly valuable. Americans value the public nature of the national parks for a few reasons but the main one is because certain goods, like national parks, are better if they are publically owned. When they are not publically owned, they lose some of their value. In his recent

[15] (Yellowstone National Park's First 130 Years, 2003)
[16] (Schullery, 2010)

book, Michael Sandel, a Professor of Philosophy at Harvard University, describes this phenomenon. Sandel says, "Standard economic reasoning assumes that commodifying a good – putting it up for sale – does not alter its character…market exchanges make both parties better off without making anyone else worse of if you assume that market relations and the attitudes they foster don't diminish the value of the goods being exchanged…many economists now recognize that markets change the character of the goods and social practices they govern."[17] The public nature of national parks meant that the spaces were more valuable than other, non-public spaces.

A recent example from Yosemite National park exemplifies how national parks would lose some of their value if they were managed privately. In 2011, the Sacramento Bee reported a story titled "Scalpers Strike Yosemite Park: Is Nothing Sacred?" The article discussed a recent scandal that had gone on in which permits to Yosemite campground sites were being resold over the Internet. Normally, to acquire a Yosemite campground site for a time in the camping season, a prospective camper would request a site about a year in advance and be entered into a lottery to receive a permit. Some lottery winners were recognizing that non-winners were willing to pay more than the face value for a permit and (illegally) re-selling the permits and making a profit.[18] Standard economic reasoning would argue that if the goal of Yosemite were to provide the greatest social utility, re-selling permits would accomplish that goal because people with the highest

[17] (Sandel, 2012)
[18] (Scalpers Strike Yosemite, 2011)

willingness to pay (the highest bidder for the good) would receive the good. However, the public nature of the national parks calls conventional economic reasoning into question. The editorial stated that, "The wonders of Yosemite belong to all of us, not just those who can afford to fork over the extra cash to the scalper".[19] Discussing this case, Sandel says, "They are places of natural wonder and beauty, even awe. For scalpers to auction access to such places seems a kind of sacrilege." Sandel makes the point that although national parks are intended to provide the greatest social utility that they can, they should not be up for sale because much of the utility derived from the space actually comes from the public nature of the space.[20]

The establishment of Yellowstone also led to the designation of subsequent national parks being permanent. Because Americans believe the parks are permanent, Americans come under the illusion that the parks are timeless, unchanging spaces. Although the parks are protected from all but the most dramatic political mood swings and economic downturns, the permanent status of the national parks does not mean that Americans do not have to worry about their future. The landscapes of the national parks have changed in the past – meaning they can change again. An example of change occurred in one of America's most prized federal spaces, Yosemite Valley. Below there are three depictions of Yosemite Valley. The first depiction, figure 1, is the first sketch of Yosemite Valley in 1855 by Thomas Ayres. The second, figure 2, is a painting of Yosemite

[19] (Scalpers Strike Yosemite, 2011)
[20] (Sandel, 2012)

Valley in 1865 by a famous German-American landscape painter, Albert Bierstadt. The third, figure three is a picture of Yosemite Valley from 2013. Although the two 19th-century examples are artworks and not photographs, they are commonly understood to be representative of what Yosemite Valley looked like at their respective completion dates.

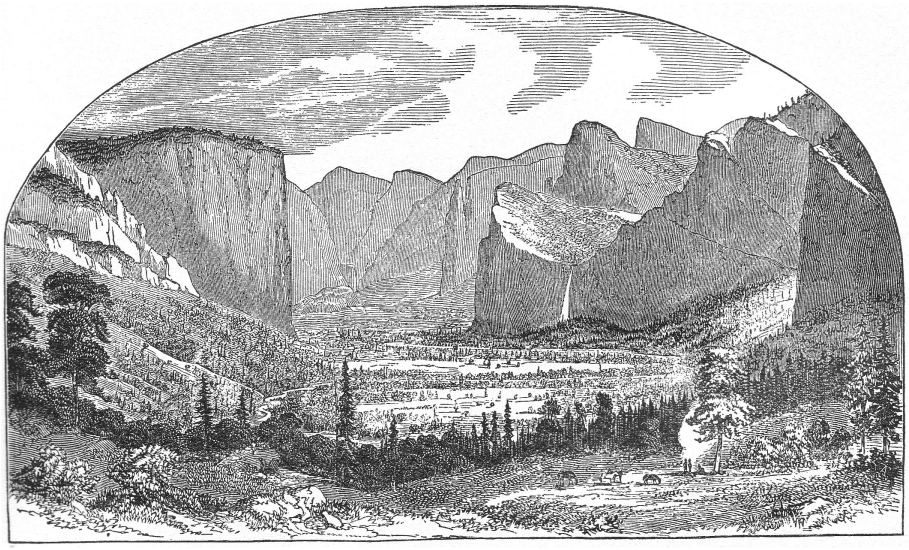
 [21]

Figure 1

[21] This drawing by Thomas Ayres in 1855 is posted on a blog for a course at the University of Maryland at: http://engl295.wordpress.com/

 [22]

Figure 2

[22] This painting by Albert Bierstadt (1865) can be found at the Birmingham Museum of Art in Birmingham, Alabama. It can also be found at: http://upload.wikimedia.org/wikipedia/commons/8/8c/Looking_Down_Yosemite-Valley.jpg

 [23]

Figure 3

In the two 19th-century depictions, Yosemite Valley is a completely different space than 21st-century Yosemite Valley. The abundance of trees that have grown in the valley is due to the valley's national park status. Before Yosemite Valley became part of a national park in 1891, Native Americans, primarily the Ahwahnechee, practiced controlled burning. The Awanachee would do this in order to expose large game to hunt. When Yosemite became a national park in 1891, however, the federal government banned burning in the valley – creating the illusion of a pristine, timeless wilderness when it was instead a very modern space.[24]

[23] This picture of Yosemite Valley was uploaded to Wikipedia by Mark J. Miller on February 5th, 2013. Mr. Miller took this picture while at Yosemite Valley. The Image can be found at: http://en.wikipedia.org/wiki/Yosemite_Valley

[24] (Spence, M.D., 1999)

The permanent status of the national parks suggests that changes like the above example of Yosemite Valley will not happen again. However, the permanent status of the national parks incorrectly encourages a timeless and unchanging interpretation of the landscapes. The national parks are neither timeless nor unchanging. The permanent status of the park reduces human intervention in the park, but does not protect it from non-human forces. Government officials can restrict hunting in the parks, but they cannot stop predators from starving due to lack of prey. Government officials can restrict where visitors can light a fire but they cannot fine rainclouds for not producing enough rain – leading to drought and fire. Until recently, the non-human forces that could change the attributes of national parks have been relatively mild. Until recently, managing the parks from non-human forces was a not a large issue. Due to climate change, the national parks will change due to non-human forces in dramatic fashion. Although Yellowstone set the precedent for permanent designation, it does not follow that the physical attributes that make up the national parks will not change.

At Yellowstone, Congress had set up a wildlife refuge by a happy accident. According to Historian Alfred Runte in his book*, National Parks: The American Experience*, "A preserved wilderness was the least of their aims."[25] But, as the turn of the century came around, Congress was beginning to realize that as land was being developed in the American West, animals were fleeing to these newly preserved spaces. The grand vistas of rock and ice were becoming wildlife refuges. Particularly, in the late 19th century, Yellowstone had become a refuge for buffalo.

[25] (Runte, 2010)

However, the near extinction of the buffalo in the 1890s solidified the notion that national parks were meant to be wildlife refuges.

In 1894, buffalo in Yellowstone National Park were disappearing. Since 1872, numerous publications about visiting Yellowstone had led hunters from all over the country to come to hunt the buffalo. Although hunting in the park borders was restricted, the park did not have nearly enough staff or resources to protect the buffalo. The park also did not have the scientific capabilities to estimate how fast the buffalo population would decline. Due to the near extinction of the buffalo, in 1894, Congress passes the first act of animal conservation, titled, "Act to Protect the Birds and Animals in Yellowstone National Park." The emergency legislation sponsored by John F. Lacey of Iowa said, “Prompt action is necessary or this last remaining herd of buffalo will be destroyed.”[26] To ensure against poaching of any kind, the bill applied to all animals in the park. The act was a signifier that fish, wildlife, and plants in the national parks were supposed to be *completely* preserved by the federal government. As more and more public, permanent, wildlife-refuge parks were created and more and more people visited the parks, the United States government was slowly realizing that the parks would have to have to be better protected if their attributes were to remain permanent.

[26] (Yellowstone Amendment Act, 1894)

Chapter 3: The National Park Service

3.1 Developing the National Park Service

On August 25th, 1916, President Woodrow Wilson signed "An Act to Establish a National Park Service".[27] What happened between 1872 and 1916 that led to the creation of a separate agency to manage the parks? And what was that agency, the National Park Service, intended to do? These questions are important because the history of the National Park Service shapes how it operates today.[28]

In the late 19th century and the early 20th century, the American people and their government were starting to realize that certain attributes of the parks might cease to exist if they did not create a better management system. This is obvious with the aforementioned case of the disappearing buffalo in Yellowstone National Park in the early 1890s. Because the National Park Service came into being after that legislation to protect the buffalo had passed, it understood its role as the agency tasked to preserve the land and animals within the borders of the parks, as they were when the parks were first established.

The success of Yellowstone paved the way for more and more federally owned landscapes. In the late 19th and early 20th centuries, the U.S. federal government acquired many new landholdings. As evidenced by the creation of more and more national parks in purchased land, the cost for making a national park was low these places. The cost was low due to cheap, abundant land and

[27] (National Park Service: History, 2014)
[28] (Dilsaver, 2009)

dramatic landscapes that, without huge investments, could be turned into a national park. The parks that sprung up included Yosemite National Park in 1891, Mount Rainer National Park in 1899, Crater Lake National Park in 1902, Wind Cave National Park in 1903, Glacier National Park in 1910, and Rocky Mountain National Park in 1915. At the time, some spaces were either not dramatic enough, not large enough, or did not had enough political backing but the Congress still wanted to protect them. In 1906, Congress passed the Antiquities Act in order to protect more landscapes. The Grand Canyon in Arizona and Devils Tower in Wyoming are examples of National Monuments protected under the Antiquities Act in the early 20th century. A list of the most important federally owned spaces (pre-1916) is below.

1872- the inception of Yellowstone National Park, America's first national park

1892- the inception of Yosemite National Park

1899-the inception of Mount Rainier National Park

1902-the inception of Crater Lake National Park

1903-the inception of Wind Cave National Park

1906-the inception of Mesa Verde National Park

1906-President Theodore Roosevelt Signs The Antiquities Act

1906- the inception of Devils Tower National Monument

1908-the inception of Grand Canyon National Monument

1910-the inception of Glacier National Park

1915- the inception of Rocky Mountain National Park

1916-President Woodrow Wilson Signs The National Park Service Act[29]

On August 25th, 1916, when Woodrow Wilson signed "An Act to Establish a National Park Service". The act created a new agency (the National Park Service) within the U.S. Department of the Interior that would be charged with the management of the 35 existing national parks and national monuments as well those national parks and national monuments that were yet to be created. Specifically, the National Park Service was intended, "to conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."[30] In other words, the National Park Service was intended to be a broad overseer of all the goings-on in the national parks for all time. The National Park Service was created because there were many parks and Congress believed it would be more effective if a single agency were created to manage them. Congress determined that the cost of establishing a National Park Service was lower than the cost of managing each park on a park-by-park basis. In addition, Congress believed that Americans valued a new, broad management service to manage their shared spaces. Because the national parks have a permanent designation, the National Park Service was to

[29] This list of national parks and national attributes has been compiled from multiple sources including (Runte, 2011), (National Park Service: History, 2014), (Burns & Duncan, 2009), and (Sellars, 1997).
[30] (National Park Service Organic Act, 1916)

preside over the national parks until forever. Under the direction of the National Park Service, the national parks would grow into a system with similar goals and regulations spanning across each park.

The National Park Service was tasked with preserving the scenic value of the national parks. The act of seeing enormous mountains or valleys or other dramatic landscapes produces scenic value. The first places that were managed by the National Park Service had high scenic value. They were monumental landscapes – often dominated by rock and ice – such as Yosemite National Park and Glacier National Park. None of the tasks that the National Park Service took on in the early years were particularly difficult because visitation was so low and the attributes that the people valued about the parks (e.g. mountains, other dramatic landscapes) were easy to preserve. The dramatic landscapes that produce scenic value were not likely to change and in the early 20th century the use of the national parks was very limited.[31]

3.2 The National Park Service in the 21st Century

Since 1916, the National Park Service has grown in scope and power with the additions of many new landscapes to manage. Indeed, the General Authorities Act of 1970 states that "the national park system, which began with the establishment of Yellowstone National Park in 1872, has grown to include superlative natural, historic, and recreation areas in every region."[32] In 2014, more

[31] (Runte, 2010)
[32] (National Park Service: History, 2014)

than 20,000 National Park Service employees work for America's 394 areas in the national park system, spanning 49 States and more than 84 million acres. The spaces they manage are often large and diverse landscapes with varieties of attributes including many different fish, wildlife, and plant species. These new landscapes include everything from the monumental landscapes of Arches National Park in Utah to one of the largest sculptures in the world, Mount Rushmore in South Dakota. The National Park Service, under the U.S. Department of the Interior is still the agency tasked with the management of America's best public lands. However, although the National Park Service still manages scenic value derived from national parks, now it also manages the biological, historical, and cultural values that these spaces hold.[33]

One of the reasons why the national park system has grown so large in the past 100 years is that the American environmental consciousness has changed. This consciousness has led to the creation of more national parks as well as different types of national parks. Everglades National Park is an example of a national park that is unlike the early national parks of Yellowstone and Yosemite. It is comprised of vast wetlands and many diverse species. The Everglades are not an obvious landscape to preserve, as Yosemite and Yellowstone are. The Everglades are not defined by large, majestic vistas as Yellowstone and Yosemite are – the Everglades are a swamp. The obvious action to take with the Everglades would be to drain it and build on it. The fact that Congress created Everglades National Park in 1934 meant that it was a new type of national park. It was a

[33] (Dilsaver, 2009)

national park created with a goal to preserve ecosystems. Rather than its scenic value, Everglades National Park was created for its biological value.

The new federally owned spaces in Alaska in the 1970s were set up with a more ecological goal as well. Indeed, according to national park historian Alfred Runte, "Alaska was our last chance to do it right, to design national parks around entire watersheds, animal migration routes, and similar ecological rather than political boundaries".[34] Although Runte notes that Americans didn't quite "do it right" (preserve all the ecosystems) in 1970, there was more preservation then there would have been if the debate about what to preserve had taken place in the early 20th century. In the early 20th century, Americans were less concerned about the ecological value of natural spaces than they were in 1970.

The National Park Service remains the agency that manages our national parks even though our national park system is larger and more varied. It is not a problem that the National Park Service has the task of managing the many different national parks. After all, the National Park Service has expanded its employment numbers as well as its sub-committees to correspond with the increasing number and type of national parks. It is a problem, however, if the National Park Service is not producing the maximum value from the spaces that it manages. One method to determine the effectiveness of the National Park Service is to look more closely at how exactly Americans value the national parks and asking if maintaining those values is best achieved by the National Park Service. If *how* Americans value the national parks has changed dramatically, America may

[34] (Runte, 2010)

want another organization to assist the National Park Service in carrying out its goals.

Chapter 4. Valuing The National Parks

"*To assess whether global climate change undermines the justification for less interventionist (or restrained) ecosystem management, such as parks and reserves, one must first determine the value of these places under conditions of rapid ecological change and then determine whether a reserve (or related) approach is an effective method for preserving that value or accomplishing the associated goals.*" –Ronald L. Sandler, Northeastern University, 2013[35]

4.1 Investigating Values

Economists determine how much someone values a good or service by how much they are willing to pay for it. The more someone is willing to pay for something, the more they value receiving the good or service. This process usually involves a market exchange. For instance, suppose more women begin buying purses with extra pockets. Economists would know that in general, women value multi-pocketed purses more than they used to and they will be willing to pay more than they used to to get them. Economists would then tell purse vendors that they should raise the price of their multi-pocketed purses. Accordingly, purse vendors would raise the price because they want to charge the maximum price they can to maximize their profits.

Valuing national parks is not as simple because they are not bought or sold in a market. While consumption of purses is very straightforward, consumption of

[35] (Sandler, 2013)

parks is very complex. People can value the parks without actually ever exchanging any money. The only market exchange involved in the national parks is entrance fees. However, the entrance fees of national parks are incredibly low compared to how much Americans value the parks. Americans are willing to pay much more to preserve their national parks than the entrance fees indicate.[36] In order to estimate just how much Americans value the national parks, economists attempt to understand *how* Americans value them and *what* Americans value about them. Investigating valuation methods along with the physical attributes that Americans value allows us to get a better picture of the current relationship between Americans and their national parks.

4.2 Use Value And Non-Use Value

Environmental economics suggests that how Americans value the national parks can be broken down into two categories: use value and non-use value. The difference between them is quite simple: someone derives use value when they visit the natural space and someone derives non-use value when they don't visit the space, but are still willing to pay to keep it around. Use-values usually involve a market exchange. In this case, the consumers reveal their preferences through a market transaction. In general, economists place their faith in a consumers "revealed preferences" to assign value to a good. Take the example of a TV. Consumers will only buy the TV if they are willing to pay at least the dollar amount that the TV is listed at. Consumers reveal their preferences through the

[36] (Bateman & Langford, 1997)

money they spend to buy the TV or not. In this case though, the TV is a strictly use-value good. The consumer derives value from using the good. National parks are unlike a TV. Consumers derive both use value and non-use value from national parks.

The primary way in which consumers derive use value form national parks is their scenic value – the value that the consumers derive from actually seeing a dramatic landscape of some kind. National parks charge entrances to get views of a landscape, however, entrance fees to parks are not good indicators of how much value the space holds. Entrance fees are kept artificially low by the National Park Service in order to encourage access. Wide public access to the national parks is one of the main goals of the NPS. By keeping entrance fees low, the NPS expands the number of people that are willing to pay to get into parks. Although this practice does allow more people to access the parks, keeping the entrance fees artificially low makes it difficult to judge how much people value the space.

For more accurate environmental economic analysis using use values, economists often use to the "travel cost" method. The travel cost methods involves an attempt to infer a willingness to pay to each individual who visited the natural space based on the ticket price of the space *and* how far he or she traveled to get to it. Usually, the longer the travel time and distance, the more use value he or she gets from going to the space.[37]

[37] (Melstrom, 2001) Although in this article, Melstrom studies the valuation of a cultural space rather than a natural space, he uses the travel cost method similar to how it would be used to evaluate a natural space.

Although use values form part of the data, non-use values complete the story on how to value national parks. A particular method that environmental economists use to estimate non-use values is called a contingent valuation survey. This method involves a survey given to those that have not traveled to the natural space asking them how much they would be willing to pay to preserve "x" ("x" meaning a buffalo herd, a plant community, etc.). Contingent valuation surveys try to estimate willingness to pay based on "stated preferences", rather than "revealed preferences". Consumers state their preferences rather than reveal them through market transactions. "Stated preferences" are often less reliable because they don't involve any actual financial consequence for the consumer.[38]

Although they are hard to estimate, economists can still compare the degree to which non-use values exist. For example, through various valuation methods, economist estimate that Americans that don't visit the parks derive a high non-use value from buffalo but have a low non-use value for invertebrates.[39] Additionally, Americans may have a high non-use value for an attribute of a particular park that they used to have a low non-use value for. As evidenced by new parks and new public agencies (e.g. EPA, Bureau of Safety and Environmental Enforcement, Office of Surface Mining), Americans now have a high non-use value for biodiversity in our parks.

Non-use values can be broken down into subcategories. The non-use values consumers derive from the buffalo example is "existence value". According to

[38] (Carson, Flores, & Meade, 2001)
[39] (Chan & Blumstein, 2011)

Robert Nelson, a Professor in the School of Public Policy of the University of Maryland, Consumers value knowing buffalo exist.[40] Non-use values also include "altruistic value". Altruistic value is the notion that consumers derive value based on the fact that other consumers will have the opportunity to use the good. In the context of national parks, non-users derive value because the parks are around for other consumers to use. Another way in which non-users derive value is through option value. Consumers derive option value from national parks when even if there is little likelihood that they will go to the national parks, it is on the table of options in what they are able to do.[41]

What all these types of non-use values have in common is that they could not be derived if Americans did not know that the national parks existed. In the modern era, pictures, videos, and other high speed communications allow Americans not fortunate enough to see the national parks in person to at least value them in non-use ways. Due to the proliferation of visual media and scientific knowledge, many people care about species loss even if they have never seen the species in person. Ken Burns and Dayton Duncan's widely successful video series, "The National Parks: America's Best Idea" both generate non-use value as well as succeed because of existing non-use value.[42] All the different ways in which Americans value the parks, through use or non-use value, make the national parks

[40] (Nelson, 2006) This paper explicitly discusses an example of someone who derives value from a perks existence.
[41] (Heberling, M. T., & Templeton, J., 2009). This paper discusses how consumers hold option value and ethical value (altruistic value) for Great Sand Dunes National Park.
[42] (Burns, K. and Duncan, D., 2009)

very valuable spaces. But, what else about the national parks makes them so valuable?

4.3 Public Good

Table 1

	Rival	Non-Rival
Excludable	Private Goods	Club Goods
Non-Excludable	Common Property	Public Goods

Table 1 shows the different types of goods bought and sold in an economy. The four types of goods can be categorized by their excludability (can someone be excluded from using the good?) and their rivalry (does someone using the good interfere with someone else using it?). Most goods, like purses, are private goods – they are excludable and rival. The price of the good excludes someone from buying it and only one person can use a purse at a time. A national park is a public good. National parks being public goods mean that they are non-rival (using a national park doesn't interfere with someone else using a national park) and non-excludable (the federal government can't prevent someone from using a national park).

Because of their non-rival and non-excludable nature, public goods aren't bought and sold in a typical marketplace and they inherently have high non-use value. This reinforces the idea that entrance fees are not nearly enough to indicate how much Americans value the national parks. However, non-use values cannot be calculated exactly. What economists can do is estimate the extent to which non-use values exist. In the context of national parks, every person that participates in ownership (each American), regardless of whether they ever go to a national park,

derives a small amount of value from the parks. The small amounts of non-use value (exitence, altruistic value, option value) add up into a large amount of willingness to pay value. For example, if every American were willing to pay one dollar to save the buffalo from extinction, the buffalo would receive a roughly 315 million-dollar wall of support. Imagine if the average American would be willing to pay around 10 dollars to save the buffalo. This would mean that the non-use values of the buffalo would add up to 3.15 billion dollars. Public goods have a huge amount of value precisely because of their common ownership.

Although all these use values and non-use values of public goods are difficult to precisely calculate, the collective use value and non-use values for the America's best public goods, the national parks, is higher now in 2014 than it was in 1916. Access to the parks has increased (use value) and knowledge and concern about the parks and their characteristics has increased (non-use values). All these values – use and non-use – combine to give the large overall value that Americans have for keeping the national parks intact.

4.4 Attributes and Ecosystems

Americans cannot derive use-value or non-use value from their collectively owned parks if the parks do not contain any physical attributes from which they

can derive value (e.g. mountains, bears, cacti). Thinking about how Americans value the national parks is only useful if we know what value-producing attributes exist in the parks. But what are the physical attributes in those spaces? Different attributes are valued higher and lower than others (different attributes require different dollar amounts to keep the same). Table 2 is an example of a park with six attributes. Attributes A, B, C, D, E, and F are different attributes of a park. An example of an A attribute could be small mountains, while D would be large mountains. Each attribute has either different levels of importance or different levels of difficultly to keep the same. Both A and D are easy to keep the same, but Americans value taller mountains much more than Americans value smaller ones. An example of a B attribute could be a particular plant community; vulnerable to change due its delicate ecosystem it lives in. An E attribute could be salmon. Salmon also live in delicate ecosystems but Americans value salmon much more than they value a plant community. A C attribute could be any species near extinction that we don't particularly value, such as an invertebrate in vulnerable ecosystem. An F attribute could be the Joshua Trees in Joshua Tree National Park – Americans value these trees but they are impossible to keep the same because of their extremely delicate climate requirements.

Table 2

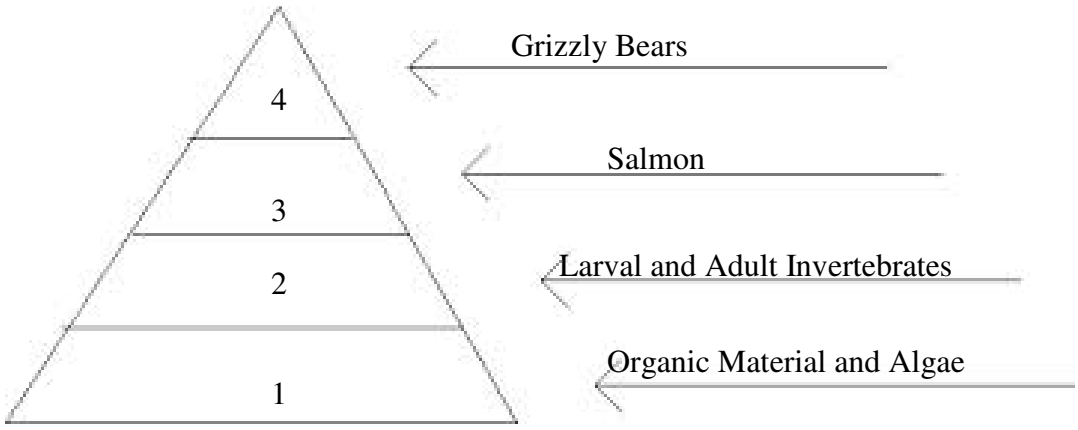
		Difficulty		
		Easy	Challenging	Impossible
Importance	Low	A	B	C
	High	D	E	F

Although attributes help Americans define their parks (Park X has buffalo, Park Y does not), Americans actually value the national parks because the parks have *many* attributes that interrelate. Some attributes do have more value than others (often called more "charismatic" than others), but all the attributes are related.[43] Indeed according to Biologists at UCLA Daniel Blumstein and Alvin Chan, "Despite dominating the planet's biodiversity, invertebrates have rarely been the focus of conservation, even though they play a crucial role in a variety of different ecosystems".[44] If Americans want to preserve their charismatic species, like buffaloes or wolves, they must preserve the other attributes that sustain the ecosystems. What Americans are really interested in doing, then, is preserving *ecosystems.*

Preserving attributes necessitates preserving their ecosystems – without an ecosystem, these attributes that make up the national parks, like the buffalo or the salmon, would have no field to graze in or stream to swim in. Figure 4 below shows how particular attributes necessitate the existence of other attributes. Although Americans place the highest value on the attribute of "Grizzly Bears" (with a value of 4), it would not exist without the salmon to eat, and the salmon would not survive without the invertebrates, and the invertebrates would not exist without the organic material and algae. All attributes rely on a stream ecosystem to exist.

[43] (Chung et. al, 2010)
[44] (Blumstein and Chan, 2011)

Figure 4



In 1894, Americans valued the buffalo so they saved it. But now, scientists know that the grass that the buffalo eats must exist in order for the buffalo to exist. Even if most Americans do not understand the ecological importance of smaller, less-charismatic organisms, like grass, Americans are interested in the preservation of their ecosystems to preserve the things they value more.

Another example of Americans valuing ecosystems is the case of the spotted owl in the northwestern corner of the United States. In 1986, an environmentalist group from Washington State petitioned the U.S. Fish and Wildlife Service to declare the Northern Spotted Owl as a threatened species. What the environmentalist group was really interested in, however, was saving the lush, mossy, old growth forests that make up a large portion of the northwestern United States. In 1990, the U.S. Fish and Wildlife Service declared that the Northern Spotted Owl is a threatened species and logging companies, much to their chagrin, had to lessen their efforts in areas where the spotted owl had been reportedly

sighted or was nesting.[45] The ecosystem of the Northern Spotted Owl has been protected ever since. And, because of the permanent status of the national parks and the National Park Service, barring any drastic legislation or huge economic crisis, the attributes within federally protected spaces will not change due to human reasons. However, the physical attributes from which Americans derive value can change from non-human factors – like ecosystem change. And, as the NPS continues to monitor and manage ecosystem health, their task will be increasingly difficult due to climate change.

Chapter 5: The Effects of Climate Change

5.1 Attributes and Ecosystem Change

[45] (Andre & Valasquez, 2014)

The changes to America's ecosystems are going to matter because Americans value the national parks as they are – as complete, preserved ecosystems. The value-producing attributes of the national parks (elk, buffalo, trout) are going to become threatened if they are not already.[46] Lee Hannah, a Senior Fellow of Climate Change Biology at UC Santa Barbara says, "The broad effects of climate change are increasingly seen as posing a significant threat to the survival of many plant and animal species."[47] As Hannah notes in a recent paper titled *Conservation of Biodiversity in a Changing Climate*, the attributes within national parks depend not only on protection from human intervention, but also depend on the stability of natural systems. A warmer, more erratic climate means altered biotic and abiotic features of the parks.[48] The Center For Park Research, a subsidiary of the National Parks Conservation Association, published a report in 2011 titled "The State of America's National Parks". In the report, the authors discuss a 10-year survey of 80 National parks, highlighting critical issues that the national parks are facing today. One of the "serious challenges" discussed at length in the report is climate change. In the section of the paper discussing climate change, the authors note that, "It is important to recognize that climate change is more complicated than simple fluctuations in air temperature or losses of individual species; it is a landscape issue that affects the health of entire ecosystems."[49] The authors note that climate change will affect species *directly* or *indirectly*. Direct effects include altering an ecosystem such that the organism's

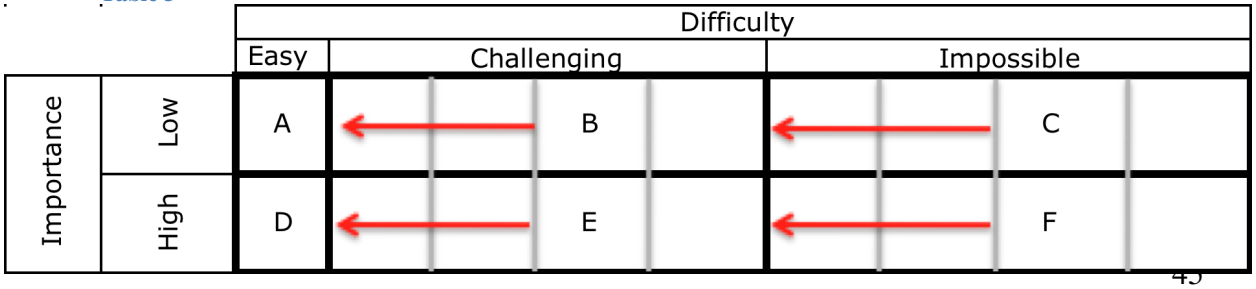
[46] (Hoegh-Guldberg et. al, 2008)
[47] (Hannah et al, 2002)
[48] (Hannah et al, 2002)
[49] (The State of America's National Parks, 2011)

body will not be able to handle the physiological stressors, and indirect effects include an organism's food chain disappearing, among others. In any case, the authors claim that the *ecosystems* are really what must be protected.[50]

But what exactly does climate change mean for the management of America's ecosystems? According to national park scholar and author, Alfred Runte, climate change is going to "demand more of everything".[51] By this, he means more government employees, more research, and more thoughtful planning, which really means more money. Essentially, keeping the things Americans value in national parks the same will be more difficult (more costly) as the climate gets warmer and dramatic climate events such as droughts and floods happen more frequently.

Specifically, climate change means that some fish, wildlife, and plants will have to migrate north, to higher altitudes, or to a completely new area. This means that the National Park Service will have a tough time keeping every attribute of the parks "for everyone, for all time". Some attributes that used to be easy to save will become challenging and some that are challenging to save will become impossible to save. The attribute table below represents the relative difficulty between attributes under climate change. The number of attributes that are challenging to save has increased (increase in the sizes of boxes B and E) and the number of attributes that are impossible to save has increased (increase in the sizes of boxes C and F).

Table 3



Indeed, certain attributes are more vulnerable to climate change than others. The additional attributes that have been added to box B, C, E, and F are those attributes. For example, fish, wildlife and plants that live in stream ecosystems are particularly vulnerable. The main limiting factor of streams is often dissolved oxygen levels. With warmer temperatures as well as changes in storms and droughts, dissolved oxygen will become more varied and unpredictable. With the change in dissolved oxygen, fish like the brown trout in Yellowstone are in serious trouble.[52]

Animals and plants that live at high altitudes are particularly vulnerable to climate change as well. According to Ben Minteer, an expert on global environmental change at Arizona State University, "The fate of many species that live at high elevations hangs in the balance. A warming habitat may literally push them off the top of the mountain as their high-peak environments disappear."[53] The plants and animals will literally have nowhere else to go. Bighorn sheep, for example, thrive at higher elevations during the summer months in Rocky Mountain National Park. When the summer becomes too warm for the sheep and they can't climb any higher they will likely die or be forced out of the park.

There are some attributes of the national parks that Congress is not going to be able to save because the dollar amount to save them would be too high. These attributes, depending on their importance, would fall in either box C or F. For

[52] (Easley et. al, 2009).
[53] (Minteer & Collins, 2010)

example, the National Park Service will not be able to save the glaciers in Glacier National Park. These particular glaciers will be gone forever in 20 or so years, regardless of human intervention. According Astrid Caldas, and ecologist and Policy Fellow at the USAID Bureau for Food Security, the Quino butterfly will also likely be impossible to save. She says that the Quino butterfly is likely to migrate north due to a changing climate; however, its path north would lead directly into the city of Los Angeles. In order to be saved then, Congress would have to legislate to create a migration path through the city or relocate the animal entirely – both extremely costly and therefore impossible options.[54] The glaciers in Glacier National Park and the Quino butterfly will likely fall victim to climate change. For the attributes that are in the realm of possibility to keep the same in the coming years, it boils down to– how should America best respond to the coming changes in the national parks?

5.2 Solutions To Ameliorate The Effects Of Climate Change

Solution One: Management Inside The National Parks

In order to combat the effects of climate change, the National Park Service, with help from other branches of the U.S. federal government, are managing inside the national parks. In 2009, the Environmental Protection Agency published a report on climate change titled, "A Framework for Categorizing the Relative

[54] (Caldas, 2012)

Vulnerability of Threatened and Endangered Species to Climate Change". In the beginning of the report, the authors say, "Climate change, either acting alone or by exacerbating the effects of these current stressors, may constitute an important new threat for many of these species."[55] In the report, the authors outline 10 major factors that determine a species' vulnerability to the coming effects of climate change. The ten factors are listed in the table below.

[56]Components of species' potential physiological, behavioral, demographic, and ecological sensitivity to Climate Change

Table 4

1) Physiological vulnerability to temperature change	(6) Likely extent of habitat loss due to climate change
(2) Physiological vulnerability to precipitation change	(7) Abilities of habitats to shift at same rate as species
(3) Vulnerability to climate change-induced extreme weather events	(8) Habitat availability within new range of species
(4) Dispersive capability	(9) Dependence on temporal inter-relationships
(5) Degree of habitat specialization	(10) Dependence on other species

[55] (Galbraith & Price, 2009)

[56] (Galbraith & Price, 2009)

The report discusses how each variable will be measured (i.e. a scale of 1 to 4). For example, salmonoids have a score of 1 (e.g. highly vulnerable) for number 1 because they are very vulnerable to water temperature changes. This table helps rank which species will be more vulnerable than others, although the EPA admits in the report that data on vulnerability is scarce and speculative at best. Regardless of methods the EPA uses to determine which species are particularly vulnerable, the point it misses is that Americans are not just concerned with losing a particular species; they are really concerned with ecosystem loss. And ecosystems are made up of many, many species. Although certain species are not particularly vulnerable, it doesn't mean that they are not in danger. According to Hugh Possingham, an expert in environmental decision-making at Australia's University of Queensland, "our obsession with celebrity species" is likely detrimental to as many as thousands of other creatures in need.[57] Mr. Possingham would argue that America must not manage its habitats by attending to needs of one vulnerable species at a time. If they do so, they risk losing many other species and entire ecosystems in the process. America must instead monitor ecosystems, holistically, in order to save the maximum number of species and ecosystems.

In some national parks, there is a program called the National Park Service Inventory and Monitoring Program. The Inventory and Monitoring (IM) Program is tasked with getting baseline data of what attributes are in the park borders and then forecasting the data based on different climate change scenarios. The IM

[57] (Possingham & Salt, 2013)

Program also looks at how to transfer best practices from park to park.[58] Scientists in the IM Program examine the health of similar species in similar ecosystems in different parks. Stacy Ostermann-Kelm, a program manager with Program states that, "Each park is unique in the challenges they face, yet they have important commonalities".[59] Although, this is a very forward-looking program, the scientists working under the Inventory and Monitoring Program only gather data on attributes *within the borders of the parks*. Monitoring ecosystems takes more than just managing inside the parks. According Jeff Yeo, a NPS scientific consultant and expert on the grasslands of the American West, in a recent interview about his work at John Day Fossil Beds National Monument –

> Monitoring is quite complex because the systems that we can try to monitor are quite complex and so when you think about this, its an ecosystem – its not just a single plant like this bluebunch wheatgrass or this sagebrush. It's a variety of plants and soils and topographies and elevations. And so how do you look at that complexity and how do you monitor it effectively? That is a tough challenge.[60]

A tough challenge indeed – especially when federal agencies are only managing inside the parks – and what they are trying to monitor (ecosystems) are not bound by the borders of the parks. According to Tom Rodhouse, an ecologist with the National Park Service, NPS employees must do their best to equip the national parks' *ecosystems* with tools to better adapt to climate change. Rodhouse says:

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[58] (Inventory And Monitoring in Parks, 2014)
[59] (NPS Inventory and Monitoring: Mediterranean Coast, 2013)
[60] (NPS Inventory and Monitoring: Sagebrush Steppe, 2012)

> It [the climate] is changing at a rate that is unprecedented in the historical record but also the fossil record and the prehistoric record. How ready are some of these ecosystems, how able are some of these ecosystems to adapt to drastic changes that are happening very quickly? We need to assist the ecosystem to handle dramatic changes.[61]

Dan Reinhart, a resource manager at Yellowstone National Park also deals with climate change inside his park. Reinhart, a NPS Resource Manager and tree expert at Yellowstone National Park, is concerned with the health of the whitebark pine trees in his park. Reinhart knows that the whitebark pine is an important habitat for animals such as the Clark's Nutcracker and an important feeding source for the Black Bears of the park. The trees are currently suffering due to white pine blister rust – a fatal, invasive fungus – that flourishes in a warmer climate. By isolating trees that are resistant to the fungus, and replanting the cones from those specific trees, he says he is promoting the health of the ecosystem.[62] Reinhart is also concerned with the recent invasion of the mountain pine beetle and the damage the beetle is doing to the whitebark pines. The beetles also do well in warmer temperatures. As of now, Reinhart admits he has no solutions to stop the ever-increasing numbers of beetles or fungi.[63] What Reinhart needs, perhaps, is a new agency to help him manage the beetles and fungi – an agency that can manage beyond the borders of the park to stop the beetles and fungi from entering the park entirely.

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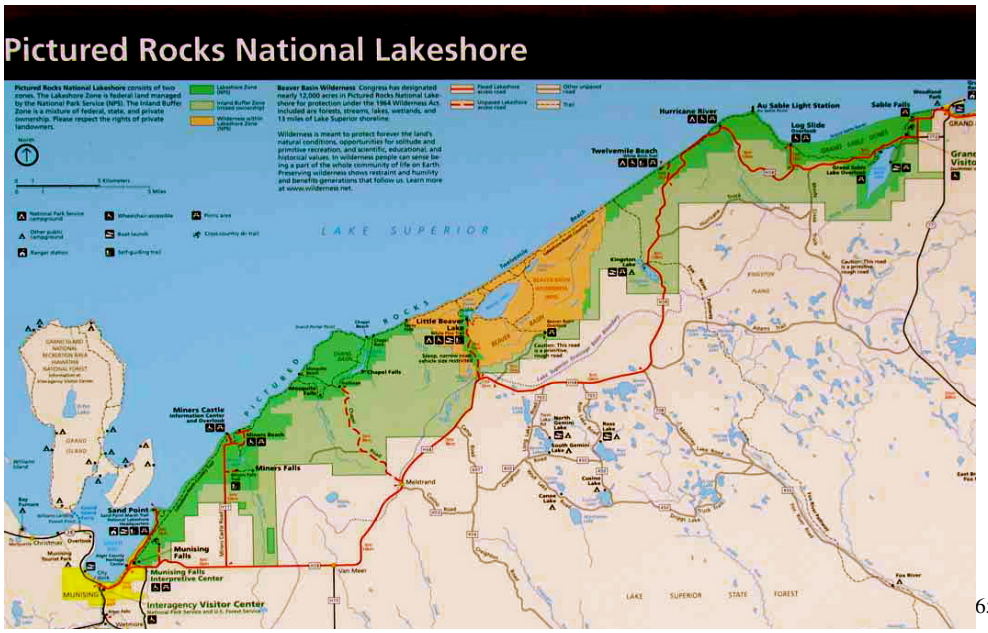
[61] (NPS Inventory and Monitoring: Sagebrush Steppe, 2012)
[62] (NPS Inventory and Montoring: High Elevation Parks, 2013)
[63] (NPS Inventory and Montoring: High Elevation Parks, 2013)

Solution Two: Buffer Zones

Buffer zones are another way to deal with mitigating the effects of climate change on ecosystems. Buffer zones would be areas outside national parks that would serve as a migration spaces as well as to encourage proper ecosystem management in and around the national parks. The strategy would consist of broad, multi-partnered management practices. A recent success story of a park with a buffer zone is underway along the shores of Lake Superior in Michigan – Pictured Rocks National Lakeshore. The park consists of three zones. See the map below. The darker green is the park. The lighter green is the buffer zone. The orange is a specially protected and inaccessible wetlands area. The park (the dark green) is a closely monitored section of shoreline on Lake Michigan, owned by the national park service. The buffer zone (the lighter green) exists a bit inland of the shore and is owned by several other parties including private citizens, corporations, and the State of Michigan. The buffer zone is intended to preserve the *ecosystem* of the shore (the park). The setup of the Pictured Rocks is unique because the National Park Service manages the first zone and other stakeholders manage the buffer zone.[64] This setup necessitates communication and cooperative management between landowners in these two zones. Since 1966, there has been a successful partnership between the NPS and the stakeholders. All the managers of the land have worked together to maintain overall environmental health.

[64] (Burde, 2013)



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Yellowstone National Park is in particular need of a buffer zone (especially under a changing climate). According to Barb Cestero at the non-profit group, the Greater Yellowstone Coalition (GYC):

> As large as Yellowstone is, it is not sufficient to protect what we value about it: its diverse free-roaming wildlife, its grand geysers, its mighty rivers and the native fish that inhabit them. All are dependent on lands that surround the park. Wildlife leaves the park in the fall to winter on lower-elevation lands. Fish migrate up and down rivers. Even the geysers depend on water recharge systems outside the park to keep them vibrant. It truly takes an ecosystem to protect a national park[66]

According to Ms. Cestero, the entire ecosystem of Yellowstone must be protected in order to protect what Americans value about the park. Indeed, according to Rick

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[65] This image can be found at http://cherylharner.blogspot.com/2013/07/a-superior-shore.html

[66] (Cestero, 2012)

Reese, another member of the GYC, "If the grizzly bear in particular were to survive in the continental United States regulations governing the lands adjacent to Yellowstone and Glacier national parks would have to accommodate the bears need to wander freely".[67] Currently, the Greater Yellowstone Coalition, working with 98 member businesses and 44 non-profit organizations helps manage the yearly migration of the animals in the Yellowstone National Park.[68] But what happens when the *entire ecosystem shifts north* due to climate change? Under climate change, the grizzly bear will be migrating permanently rather than seasonally. Perhaps federal buffer zones – essentially extending the park northward – would be better to ensure the safe, permanent migration of the attributes and the ecosystem.

The relative *small size* of Pictured Rocks National Landshore and the *uniformity* of the park's ecosystem have made it a success story. Buffers around larger parks, such as Yellowstone, would necessitate increased amounts of partnerships with increasing numbers of stakeholders. New buffers around larger parks would necessitate many different management rules because there are many different kinds of ecosystems in larger parks.

Solution Three: New National parks

[67] (Reese, 1984)
[68] (Cestero, 2012)

In a changing climate, America may decide that it wants to set up entirely new and permanently designated national parks. In fact, new national parks would share a common goal with Everglades National Parks' to protect biodiversity and ecosystems. New national parks could have two different functions. Each new park could fill one or both functions. The first function of a new national park would be to protect ecosystems with their existing characteristics. The second would be to create preserves for species that can no longer survive in their former habitat. Either way, new national parks would be a solution to the impacts of climate change by protecting new ecosystems. Whether those new parks are populated with existing attributes or new attributes (e.g. animals that were moved to the new park), they would still preserve more of what Americans value, ecosystems. New national parks could be the solution to climate change that is the most properly aligned with what Americans value. Ben Minteer of Arizona State University believes that entirely new national parks will be set up around the globe. Minteer says:

> We have spent decades trying to preserve wild species from direct threats like habitat destruction, overhunting, and pollution. Historically, humans have protected species by creating parks and reserves to safeguard them in their native ecosystems…. climate change is forcing us to rethink what it means to save a species in the 21st century. If climate change continues unabated and as rapidly as a few models predict, saving at least some species will require solutions more radical than creating parks and shielding endangered species from bullets, bulldozers, and oil spills: It will require moving them.[69]

[69] (Minteer, 2010)

Ove Hoegh-Guldberg, the Director of the Global Change Institute at the University of Queensland, agrees with Minteer, saying:

> Moving species outside their historic ranges may mitigate loss of biodiversity in the face of global climate change...We must contemplate the possibility that some regions of the Earth will experience high levels of warming (.4 degrees C) within the next 100 years, as well as altered precipitation and ocean acidity. Under these circumstances, the future for many species and ecosystems is so bleak that assisted colonization might be their best chance.[70]

Richard Hobbs, Professor of Biology at the University of Western Australia agrees. He says:

> Whereas historically we have taken on the role of preservers of species and ecosystems, in the 21st century we will likely find ourselves pressed into a very different role: makers of novel ecosystems for stressed populations.[71]

Ronald L. Sandler, Director, Ethics Institute at Northeastern University agrees. He says:

> The distinctive features of global climate change undermine the feasibility of place-based preservation. The rate and magnitude of change are too high, the amount of species at risk are too great, and the causes too far beyond the control of ecosystem managers to try to preserve individual species and modern species communities where they are, when they are imperiled as a result of rapid ecological change.[72]

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[70] (Hoegh-Guldberg et. al, 2008)
[71] (Hobbs et. al, 2009)
[72] (Sandler, 2013)

Conventional wisdom on the management of America's ecosystems has already changed. Experts agree that management strategies must adapt to the rapidly changing physical characteristics of the national parks. Just how dramatic climate change will be is uncertain but what is certain, however, is that there will be irreversible changes in the land due to natural phenomena. The solution to the coming climate change-related issues will involve some combination the three aforementioned solutions, at different levels across different ecosystems. Each of the solutions, however, would be better managed under one integrated agency with the specific goal to protect America's ecosystems – a National Ecosystem Protection Service.

Chapter 6. Developing A National Ecosystem Protection Service

6.1 Adaptive Management

Out of the three solutions to manage the effects of climate change, the National Park Service is only doing solution one – managing inside the parks. Notably, this is what the National Park Service is tasked with doing – preserving the parks. However, if Americans want to protect what their ecosystems, solutions one, two, and three will have to be done in different combinations in different landscapes. A National Ecosystem Protection Service would do a better job at managing the solutions than the National Park Service.

The goal of the National Ecosystem Protection Service would be to preserve ecosystems. Ways to achieve to the goal of ecosystem preservation could

take many forms including adapting the interior of the parks, creating buffer zones around existing national parks, or creating new national parks. Depending on the exact effects of climate change, Americans might want different solutions in different levels in different parks. A National Ecosystem Protection Service would operate with a similar goal as the National Park Service. It would carry out society's demand for preserved ecosystems for everyone, for all time. While the National Park Service does govern general ecosystem health, the NPS is only tasked to operate within the borders of the parks. Because the borders of the national parks are not walls, and some of the fish, wildlife, and plant communities will be forced to migrate, another agency must be created to manage ecosystems. America needs a new service, one that is aimed at protecting fish, wildlife and plants and their ecosystems within the national parks and outside of the national parks. Maintaining *broad* ecosystem health is not within the capabilities of the National Park Service.

The U.S. Fish and Wildlife Service and the Endangered Species Act already protect vulnerable species, but they do not protect vulnerable ecosystems. In the early 1970s, America decided that it needed a strict law to curb the extinction of species. According to environmental lawyer John Kostyack, though, "While the ESA is lauded as one of the country's most powerful tools of environmental protection, the statute may not be strong enough to protect wildlife and habitat in the face of global warming".[73] Climate change will be dramatic and unpredictable. It will put a strain on the system of species by species protection.

[73] (Kostyack & Rohlf, 2008)

Perhaps, when the effects of climate change threaten species that do not have the ability to migrate, EPA grants will continue to let National Park Service protect some species in the parks. However, this is not what Americans value. They value ecosystems. And it is ecosystems that Congress ought to protect. Managing these complex ecosystems must be left up to an organization that is allowed to make smart, ecosystem-based decisions. If America does not make ecosystem-based decisions, it not only risks over-focusing on saving one particular species, it also forgoes the opportunity to learn from diverse, biologically productive ecosystems. The fact that Americans value these diverse ecosystems indicates that Americans would seriously regret not saving them if they were gone.

6.2 Towards A Broad and Scientific Type of Management

The National Ecosystem Protection Service would broadly manage ecosystem health. It would act as a broad authority to work with the federal, state, and local agencies to ensure the safe migration of species and their ecosystems that Americans place value on. The National Ecosystem Protection Service would be one integrated agency. It would take input from federal, state, and local officials with partnerships from private landowners to cooperatively manage America's ecosystems. In the conclusion of their report titled "Parks in Peril", scientists at the Rocky Mountain Climate Organization suggest that the national parks expand their borders and perhaps even create new national parks (solutions two and three).[74] A broad management service to manage ecosystems would be able to work with

[74] (Easley et. al, 2009)

federal and state agencies as well as local governments and private citizens and other landowners to set up buffer zones or new parks. According to the Center for Parks Research, in a 2011 report, holistic management leads to better preservation. In the report, they state:

> Management approaches that consider parks as part of the greater landscape and community fabric are better able to achieve stewardship goals. Our assessments found that parks that proactively reach out to other stakeholders— including park friends groups, other federal agencies, and local governments, businesses, and nonprofit groups—develop relationships that positively affect resources…some resource challenges facing individual parks are too large or too complex for the staff at those parks to manage.[75]

In order to accomplish such broad cooperation and management, the National Ecosystem Protection Service must be powerful enough to instill cooperation among units of government that are now scattered. Additionally, the final decisions about ecosystem management must come from the top-down primarily because regional or local interest groups are likely to place a high value on ecosystems close to them and less value on ecosystems that are geographically distant from them. The National Ecosystem Protection Service must do exactly what its title implies – protect our nation's ecosystems. The NEPS may discover that data-gathering and report writing are better done at the local and state level, but it ought to make the final decisions for policy on the federal level – with the interest of the American public in mind.

[75] (The State of America's National Parks, 2011)

Although the NEPS must necessarily be broad and powerful to accomplish its goals of ecosystem protection, it does not necessarily follow that the NEPS must purchase any new land. This is an essential difference between NPS and the NEPS. One of the reasons that the future management of America's ecosystems should not be done by the National Park Service is the NPS would declare new, federally owned spaces. If the NPS were to manage the effects of climate change through creating buffer zones or new parks, they would likely buy the land adjacent to the park or buy land for new parks. Buying land is a poor strategy because it necessitates a strong federal hand evicting current landholders. A NEPS, on the other hand, would coordinate with current landowners and opt for the best possible outcomes for all parties involved. The National Ecosystem Protection Service would be more interested in ecosystem preservation rather than setting up new public spaces for Americans to travel to. The National Ecosystem Protection Service could even allow many people to live on the land of the new federal areas they create, while the National Park Service would just purchase the land and fence it off.

A National Ecosystem Protection Service would scientifically manage ecosystems' health. The primary task of the NEPS would be determining what would happen to America's ecosystems under different scenarios of climate change. To do this, the NEPS would first establish baseline data on America's most treasured ecosystems, those in America's national parks. Scientific specialists will be able to determine which ecosystems are the most vulnerable and why. The

National Ecosystem Protection Service task would then be to share and replicate the best management practices in the interest of preserving ecosystems.

At the beginning of the tenure of the National Ecosystem Protection Service, it would primarily focus on gathering data on indicator species. Indicator species, like the Pika in Rocky Mountain National Park, are delicately balanced with their ecosystems. Their population levels and migration patterns are exceptionally dependent on fragile characteristics of their ecosystem.[76] It would be crucial for the NEPS to work with existing data gathered by the National Park Service's Inventory and Monitoring Program. The NEPS would work with employees of this program to gather existing data to make the work that the NEPS does more robust.

The NEPS could be modeled after an effort already in place, titled the Chesapeake Bay Program. Since 1983, The Chesapeake Bay Program is an effort that combines federal, state, and local environmental officials as well as partners from non-profit groups and academics institutions to monitor and manage the different ecosystems of the Chesapeake Bay. Non-technical teams focus on community outreach and plan and set goals. The technical teams (such as the Oyster Metrics Team or the Fish Passage Workgroup) report their data to data specialists and then the data specialists communicate their findings to officials at all levels of government who would make policy decisions. The Chesapeake Bay Program not only works between federal, state, and local officials, it works among each level of government as well. For example, on the fish passage workgroup sits

[76] (NPS Inventory and Monitoring: Pikas Living on the Edge, 2013)

Ben Hutzell, of the U.S. Fish and Wildlife Service, Angela Sowers of the U.S. Army Corps of Engineers, and David O'Brien of the National Oceanic and Atmospheric Administration.[77] Each individual is a U.S. federal employee but they work together to ensure fish passage in the Chesapeake Bay.

Like the Chesapeake Bay Program, the National Ecosystem Protection Service would have data gathering specialists, data reporting specialists, and subsequent policy implementation specialists, and bring together multiple institutions on multiple levels of government. This broad, collaborative, scientific effort would allow the National Ecosystem Protection Service to best manage America's ecosystems.

Chapter 7. Concluding Remarks

The national parks are likely America's best idea, save for Thomas Jefferson's ever quotable, "life, liberty, and the pursuit of happiness". The national parks represent a difficult and careful decision to not commodify the land for minerals, furs, and highways, but rather to preserve landscapes for everyone, for all time. The national parks are a link to a collective and uniquely American past. They are part of the American social fabric. They are part of American nationalism. They are part of how Americans identify themselves. Although questions of access still remain a top concern for national park administrators, national parks remain a great equalizer – places where Americans can be rich or poor, healthy or sick, black or white, and appreciate them as a collective good. But,

[77] (Chesapeake Bay Program: Science, Restoration, Partnership, 2012)

the parks and everything they represent are at risk due to climate change. I believe that the creation of a National Ecosystem Protection Service is the best way to manage that risk.

The National Park Service, so far, has done a good job incorporating new parks, and protecting vulnerable species within the boundaries of the parks. However, conventional wisdom on how to managing the parks has changed. According to Ben Minteer, "We simply have no choice but to think beyond the traditional parks-and-preservation model if we wish to save species in an era of rapid climate change."[78] I believe we do wish to save as many species as possible and that the best way to do that is to set up a new agency with the specific task of ecosystem management. The National Park Service is not incapable of managing many of the coming changes to America's ecosystems, but a National Ecosystem Protection Service would be a more effective manager. Because climate change will force ecosystems to move, a new management system must be able to work beyond park borders. The National Park Service is only in charge of the lands within the parks borders – and those borders do not define ecosystems. A team of specialists and administrators that can link ecosystems at the local, state, regional, and federal level are best suited to manage the changing ecosystems.

The creation of a National Ecosystem Protection Service would help the United States to be a world leader in forward-thinking environmental stewardship. As National Park Service Director, Jonathan Jarvis notes:

[78] (Minteer & Collins, 2010)

> Looking back to the context of the prevailing, early 20th-century sentiments for development and prosperity, the vision of "setting aside" areas to conserve as national parks in an "unimpaired" condition was a remarkable, forward-thinking idea.[79]

Just as the national parks were America's idea, so could a nation's ecosystem protection service be. Americans must again be forward thinking. They must step up to face this critical issue of climate change with a new agency that is equipped to assist in the management of ecosystems in a rapidly changing natural world. I recommend that Congress set up a National Ecosystem Protection Service and continue the legacy of forward-thinking, American ideas.

The creation of the national park system remains a great American achievement. The idea itself of a federal operated space for the intention of conservation and public use has spread across the world. But if America is going to continue to protect its natural spaces, Congress has to be the one doing the protecting. Congress must act to save America's parks and the ecosystems they protect. John Muir recognized the power that Congress had to preserve natural spaces. Muir said:

> Any fool can destroy trees. They cannot run away; and if they could, they would still be destroyed – chased and hunted down as long as fun or a dollar could be got out of their bark hides, branching horns, or magnificent bole backbones. Through all the wonderful eventful centuries since Christ's time – and long before that – God has cared for these trees, saved them from drought, disease, avalanches, and a thousand straining, leveling tempests and floods; be he cannot save them from fools – only Uncle Sam can do that.[80]

[79] (National Park Service Climate Change Action Plan, 2012)
[80] (Muir, 1897)

I believe in the national parks, in their spirit, and their worth. I believe that in our collective yearn for meaning, in our perpetual need to belong, we all hear the call of the wild. And national parks are where we go to answer that call. I am motivated by hopes of widespread access and use of the parks tends to nourish bodies, minds, and souls of Americans in the coming decades. I do not want to live in an America where buffalo herds who dominate the Yellowstone plains have to be relocated due to climate change– but I would rather live in that America than in one that did not try to save its best ecosystems.

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